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June 8, 1994

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Mr. William F. Caton  
Federal Communications Commission  
1919 M Street  
Room 222  
Washington, D.C. 20554

FEDERAL COMMUNICATIONS COMMISSION  
OFFICE OF THE SECRETARY

Dear Mr. Caton:

Submitted herewith on behalf of Fairfield Industries, Inc. is a Petition for Rulemaking relating to Part 90 of the Commission's Rules.

Any questions regarding the filing should be directed to the undersigned.

Sincerely,



William K. Keane

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BEFORE THE

JUN - 8 1994

**Federal Communications Commission**

WASHINGTON, D. C. 20554

FEDERAL COMMUNICATIONS COMMISSION  
OFFICE OF THE SECRETARY

In the Matter of )

AMENDMENT OF PART 90 OF THE )  
COMMISSION'S RULES REGARDING )  
SEISMIC TELEMETRY )

RM-

To: The Commission

PETITION FOR RULEMAKING

FAIRFIELD INDUSTRIES, INC.

By: William K. Keane  
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June 8, 1994

Its Counsel

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### SUMMARY

Frequency congestion in the 216-220 MHz band, combined with the increased demand for high resolution geophysical data, warrant an expansion of the spectrum available for seismic telemetry.

Telemetry is a key component in the search for oil and gas reserves. In order to help realize the national goal of increasing domestic oil and gas production, it is important that the Commission allow use of the 220-222 MHz band for geophysical exploration.

Geophysical exploration typically occurs in remote uninhabited areas and waters up to 30 miles offshore. Telemetry systems operate with very low power levels (two watts or less). Geophysical telemetry operations are vulnerable to interference from other users and the spectrum must be carefully monitored to ensure that the data streams are not interfered with. Hence, there is no risk of interference to land mobile operations -- a condition reinforced by the Petition's request for no more than a secondary allocation.

BEFORE THE  
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To: The Commission

PETITION FOR RULEMAKING

Fairfield Industries, Inc. ("Fairfield"), by its counsel, hereby petitions for initiation of a rulemaking looking toward a secondary allocation for seismic telemetry in the 220-222 MHz band. Authorizing such use will materially enhance efficiency in the search for oil and gas reserves. At the same time, such use would entail no risk of interference to primary users. In support of its request Fairfield submits the following:

I.

INTRODUCTION

Fairfield, a corporation headquartered in Houston, TX., is engaged in all phases of geophysical exploration for oil and gas. This includes data acquisition, data processing, and instrument design and manufacture.

Fairfield's clients include most major and independent oil and gas producers. The Company's exploration work in the United States has been concentrated in shallow waters (up to 30 miles offshore) in the Gulf of Mexico as well as other remote areas, such as the North Slope of Alaska and the swamps of Louisiana.

In addition Fairfield has performed extensive work overseas for foreign oil producers and governments. This work has occurred (or is occurring) in countries such as Indonesia, Venezuela, the Middle East and China.

In addition to its own geophysical exploration, Fairfield manufactures sophisticated equipment used in seismic research. This equipment has been designed to operate in the 72-76 MHz and 216-220 MHz bands, and is marketed under the trade

name TELSEIS®.<sup>1/</sup> The equipment is type accepted by the Commission for operation in the referenced bands. Fairfield's newest line of geophysical telemetry equipment, the TELSEIS® STAR System, is the most advanced seismic data acquisition system available.

In order to better understand the basis for this Petition, it may be helpful to provide a brief description of the nature of geophysical research, and the related use of radio telemetry.

## II.

### BACKGROUND

Geophysical exploration involves the simultaneous transmission of seismic data from numerous locations to a central receiver and digital recording unit. A sound source (such as a small dynamite charge) is used to introduce seismic energy into the earth's surface. The reflected energy is picked up by geophones/hydrophones, and the data is then transmitted either via cable or radio to a central receiving unit.

With older, cable-based methods each individual geophone must be hard-wired to the recorder. Given that 1500 or so geophone stations may be deployed for any one "shot", the

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<sup>1/</sup> TELSEIS® is a registered trademark of Fairfield Industries, Inc.

testing process is slow, cumbersome, and expensive. Moreover, the scope of the area which can be tested is often severely restricted.

By contrast, with radio telemetry there is no need to wire each sensor to the receiver. More sensors can be deployed over a wider area thus improving the quantity and quality of the data -- and at less cost.

Radio-based telemetry is also more environmentally protective. Much less crew movement is required than with wired techniques -- an important factor in environmentally sensitive areas such as tidal wetlands.

Thus radio telemetry techniques represent a significant improvement over older, wire-based methods for many applications. Fairfield has been a pioneer in the development of such techniques.

The heart of a radio telemetry system is, of course, the transmitters themselves. Just prior to a shot, the transmitters are activated by a tone signal from a command module; the units then simultaneously transmit low-power FM analog signals to a high gain Yagi antenna mounted at a very sensitive receiver. The data is transmitted in short bursts,

typically no more than 30 seconds every three minutes or so. The signal passes to a multiple channel mainframe and demodulator and from there to a digital recorder and tape transport.

Each seismic transmitter operates on a separate frequency with low power (1 watt) and an effective antenna height of six feet or less (the unity gain antenna is directly attached to its transmitting unit).

During the course of a typical operation, the transmitters are moved from point to point along surveyed lines normally several miles in length. When data has been collected in one area, the entire system is then moved to the next survey line where the process is repeated.

It is essential that TELSEIS® transmitters be rugged and readily portable. In land operations, for example, the members of Fairfield's exploration crews typically carry three or four TELSEIS® units at one time. In operations offshore, similar considerations of portability and durability apply. In order to achieve these characteristics, the transmitting apparatus and battery supply are deliberately kept as small and as light-weight as possible. One result is the very low output power for TELSEIS® units.

Due to the extreme sensitivity of the receiving unit and the need for accurate, uncontaminated data, geophysical operations are susceptible to interference from other users. The possibility that signals might be received from other users can result in the elimination of three channels for Fairfield's use in the same area: the channel on which the interference is received as well as the two adjacent channels. For this reason, standard operating procedures require that the spectrum be monitored before operations are commenced in order to insure the absence of interfering signals.

TELSEIS® units were originally designed to operate in the 72-76 MHz band. However, due to frequency congestion, e.g. the presence of high-powered paging transmitters, 216-220 MHz has been the band of choice for geophysical exploration in recent years.<sup>2/</sup> Unfortunately this band too has become more occupied primarily with Automated Maritime Telecommunications Service ("AMTS") users. Moreover, the Commission has allocated 218-219 MHz for interactive video data services. Report and Order in General Docket No. 91-2, 70 RR 2d 523 (1992); this too will result in greater spectrum congestion.

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<sup>2/</sup> Operation in the lower part of the radio spectrum (below 300 MHz) is essential given the necessity for light-weight, portable transmitters -- devices which operate at very low power levels in order to conserve power and hence battery size. The trade-off, however, comes with reduced range, compensation for which is obtained by operating in bands with favorable propagation characteristics.

Because Fairfield's equipment is so sensitive to interference, the increasing levels of activity in the 216-220 Mhz band have reduced the number of channels available for telemetry. This in turn reduces the efficiency and increases the cost of geophysical operations: in order to secure the same amount of data, Fairfield's crews must increase the number of shots and, hence, spend longer periods of time in the field.

At a cost of \$25,000 per day per crew, the availability of adequate spectrum has a major effect on the efficiency with which industry can search for new oil and gas reserves.

If spectrum congestion were the only factor, there would be ample basis for this Petition. However, it is not the only basis -- even more important is the march of technology in the geophysical industry.

While radio telemetry has represented a significant improvement over older methods of geophysical research, the data collected has been generally two-dimensional ("2D"). Such data is useful, but has serious limitations in its ability to reveal undiscovered reserves of oil and gas -- particularly pockets which may exist along fault lines in already-established or supposedly depleted fields.

Fairfield has been a leader in the development of three dimensional (or "3D") survey techniques for shallow offshore waters of up to 60 foot depths. Where 2D methods might entail a survey grid with quarter-mile or even half-mile intersecting lines, a 3D survey by contrast, might have spacings as low as 110 feet resulting in a much higher level of subsurface resolution.

The quality and enhanced resolution of 3D seismic surveys is such that dramatic improvement have been obtained in the rate at which successful wells are being drilled; hence 3D data, while more expensive than 2D, is a means of reducing the risks associated with a much more expensive undertaking -- dry holes. Indeed, one major U.S. producer has reported a 63 percent improvement in the rate at which it is drilling successful wells using 3D (the success rate using 2D data can be only 15-20 percent). With the search for oil and gas now often involving deep wells of 20,000 feet-plus -- each of which can cost on the order of \$20 million -- 3D is becoming an essential risk control measure.<sup>3/</sup>

At present Fairfield is able to collect data from two geophones/hydrophones (two "traces") per radio channel. With the 200 channels available in 216-220 MHz band this means that

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<sup>3/</sup> Attached is an article by Marc A. Lawrence, Senior Vice President, Fairfield, describing 3D exploration in greater detail.

Fairfield is theoretically able to collect data for 400 traces on any one shot if every channel were available. However, every channel is seldom available: interference may preclude use of 40, 60, even 80 channels out of the 200. And this makes no allowance for the greater number of channels required in order to provide higher resolution 3D. Hence, in order to survey any given area, radio telemetry crews will need to spend longer and longer periods of time at sea or in the field.<sup>4/</sup> The net result is that, if present trends continue, the cost of conducting 3D radio-based geophysical exploration may become prohibitive.

### III.

#### THE PUBLIC INTEREST WILL BE SERVED BY GRANTING FAIRFIELD'S REQUEST.

Analysis of the facts presented above compels the conclusion that the public interest would be served by a grant of Fairfield's request.

#### A. A 220-222 MHz Allocation Presents Affirmative Public Benefits.

The search for oil and gas reserves to fuel our economy continues to represent a matter of the highest priority.

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<sup>4/</sup> There is an inverse relationship between the number of channels useable for any given seismic survey, and the amount of time a survey operation requires; for example, halving the number of useable channels approximately doubles crew time and cost.

On December 9, 1993 the Department of Energy announced its Domestic Natural Gas and Oil Initiative.<sup>5/</sup> The DOE Initiative, which has also been endorsed by the Department of the Interior,<sup>6/</sup> represents an important part of the Administration's natural resource program. It is aimed at boosting markets for domestic natural gas and oil while developing a long-term strategy to reduce the nation's dependence on foreign oil.

According to DOE, while the United States has large supplies of oil and gas, the nation has become increasingly dependent upon more readily accessible foreign supplies. Initiative at 2, 4-5. In order to reduce this dependence, DOE has stressed the importance of deploying advanced exploration and production technologies such as 3D geophysical surveys. According to the Initiative, such technology "enable[es] more efficient and environmentally sound exploration and development resulting in increased reserves and fewer dry holes." Id. at 3. Indeed DOE specifically targets shallow offshore waters in the Gulf of Mexico -- an area of primary application for 3D telemetry -- as an area in need of further exploration and development. Id. at 29.

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<sup>5/</sup> See The Domestic Natural Gas and Oil Initiative: Energy Leadership in the World Economy (December 1993) (hereinafter "Initiative").

<sup>6/</sup> See letter dated March 22, 1994 from The Honorable Bruce Babbitt, Secretary of the Interior, to Dr. Robert Jordan, Chairman, OCS [Outer Continental Shelf] Policy Committee, University of Delaware.

In short, by the additional allocation requested the Commission would provide positive support for the Administration's energy policy program; i.e. the proposed allocation would assist in the location of new domestic reserves at reduced cost, in the process lessening U.S. dependence on imports and stimulating markets for U.S. production.

In addition, the Commission is charged with maximizing the efficient and effective use of the radio spectrum. Section 303(g) of the Communications Act prescribes that the agency "shall .... [s]tudy new uses for radio, provide for experimental uses of frequencies, and generally encourage the larger and more effective use of radio in the public interest." Section 7 of the Act directs the Commission to give priority to proposals for new technologies and services -- the burden being placed on opponents of such a proposal to demonstrate that it would be inconsistent with the public interest. 47 U.S.C. § 157. Fairfield's Petition is certainly consistent with the thrust of Sections 7 and 303(g).

B. A Secondary Allocation Entails No Adverse Risks for Other Users

The 220-222 MHz band is currently allocated on a primary basis for land mobile operations. The Commission determined upon this allocation in 1989 in order to provide spectrum for the development of new, narrow-band technologies. See Report and Order in General Docket No. 87-14, FCC 88-266, 65

RR 2d 219. Service rules were adopted in 1991. See Report and Order in PR Docket No. 89-552, FCC 91-74, 68 RR 2d 1654. Those rules include, in particular, a plan which makes provision for 200 channel pairs and a frequency bandwidth of 5 kHz. Due in good measure to litigation over the process used to award licenses, however, there has been little development in the band to date.

The seismic telemetry proposal made here presents no risk of interference to land mobile users, even when the primary allocation for the band reaches its potential. To the contrary, if there be any risk it is to seismic operators, not the reverse. There are multiple reasons for this:

First. The power of Fairfield's telemetry units is less than 2 watts with omnidirectional antennas attached directly to the sonobuoy or sensor.

Second. Seismic telemetry is self-policing. Due to the extreme sensitivity of the receiving unit/recorder, and the need for uncontaminated data, the spectrum is carefully monitored for the presence of extraneous signals before any test is conducted. If such signals are detected on any given channel or channels, those frequencies are not -- indeed can not -- be used.

Third. Geophysical exploration in the United States is typically conducted in remote, uninhabited areas, such as offshore waters, swamps and marshes, and the North Slope. The risk of interference to other users is therefore slight.

Fourth. To the best of Fairfield's knowledge, there has not been a single complaint concerning its operations in the relevant band (216-220 MHz). This is despite the fact that AMTS operations are widespread along the Gulf of Mexico.

Fifth. Seismic telemetry would be secondary to the primary, narrowband land mobile allocation. While in practical terms Fairfield's operations are necessarily secondary -- for the self-protective reasons noted above -- a secondary allocation provides legal assurance that narrowband land mobile operations would have priority in the unlikely event a user were ever to venture into or near one of Fairfield's operating areas.

C. Rule Changes Requested.

Commission Rule 90.238 authorizes telemetry in 220-222 MHz "as available under subpart T of this part." Rule 90.731 prescribes that licensees "may utilize their authorized frequencies for fixed ancillary signaling and data transmissions subject to certain restrictions" which include that such operation be on a secondary basis (emphasis added); otherwise the

Rule precludes authorization (except for control stations) of operational fixed stations in the 220-222 MHz band. Accordingly, Rule 90.731 should be revised to make clear that 220-222 MHz systems may be licensed on a primary, i.e. non-ancillary, basis for geophysical telemetry purposes (such operations being secondary to mobile users). Moreover, the Rule should dispel any ambiguity by allowing temporary fixed operations. Suggested language for the revision is attached.

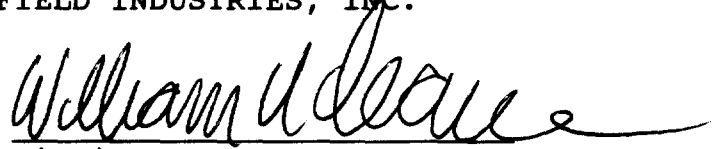
CONCLUSION

For the foregoing reasons, Fairfield urges the Commission to promptly initiate a rulemaking looking toward the secondary allocation requested.

Respectfully submitted,

FAIRFIELD INDUSTRIES, INC.

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**ATTACHMENT A**



# 3-D Seismic Rewrites Book On E&P Economics

By Marc A. Lawrence  
and Hugh Logue

Houston, TX—The shallow waters off the northern Louisiana offer a perfect example of how three-dimensional seismic surveys are rewriting the books on exploration and exploitation economics, as success story after success story proves why 3-D seismic data is giving a new lease on life to "mature" domestic oil and gas production provinces.

As a result, interpretation of 3-D seismic data doesn't make complex geology more simple. But more and more operators are convinced it is a key ingredient, as more than 80 percent of the seismic data being collected in the Gulf is now 3-D. These days, you will find more independent operators making claim to the policy: we don't drill without 3-D.

Why? The answer is simple: Computer-assisted mapping and interpretation

of 3-D seismic data is allowing independents to reduce risk and lower overall finding costs, and that is the name of the game in the oil and gas business.

While 3-D seismic is still a developing technology, its contribution to drilling methodology and economics is nothing short of revolutionary. It has, in a few short years, transformed the way oil and gas companies drill wildcats and develop fields.

Certainly, if lower cost 3-D seismic surveys can replace the higher cost dry holes which have been used to delineate the boundaries of oil and gas bearing structures, then the economic ratios under which drilling projects are evaluated change for the better. After all, the objective of an exploration company is not just to find hydrocarbons, but rather to make money finding hydrocarbons. There is a big difference.

## Defining Boundaries

Almost all prospects in sparsely drilled areas are structural traps, because defining the boundaries of stratigraphic plays is too difficult and risky. In the exploration process offshore, the traditional method of locating hydrocarbons has been to start with two-dimensional seismic and subsurface well control to locate potential hydrocarbon-bearing structure.

Step two involves the tasks of the drilling department, which evaluates a prospect by confirming and quantifying the hydrocarbons contained in the structure. But drilling a well in the highest and most obvious location doesn't provide the information needed to fully evaluate a prospect.

Instead, an operator determines the minimum size of reserves needed to be economic, then drills one or more wells along this "economic boundary" to determine whether the hydrocarbons extend to

FIGURE 1A

## 2-D Migration

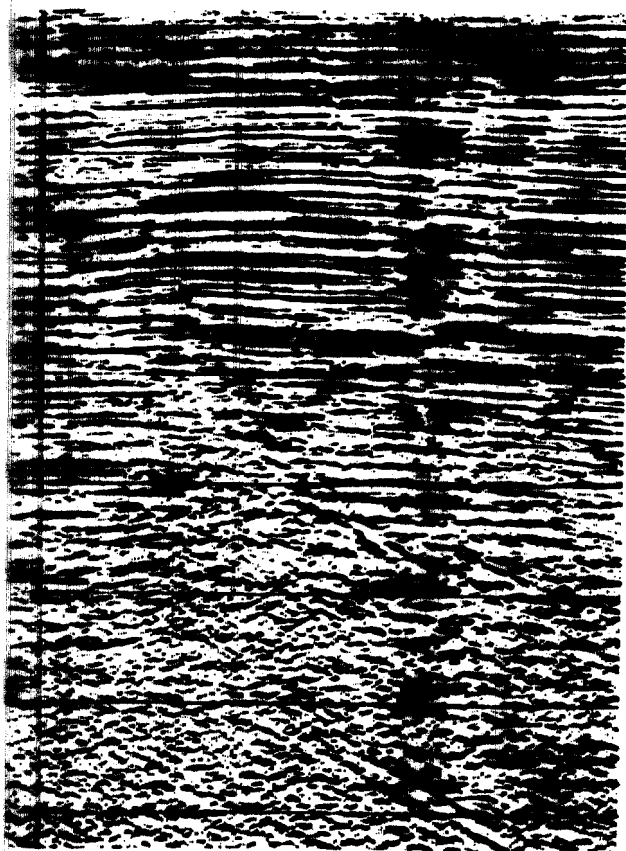
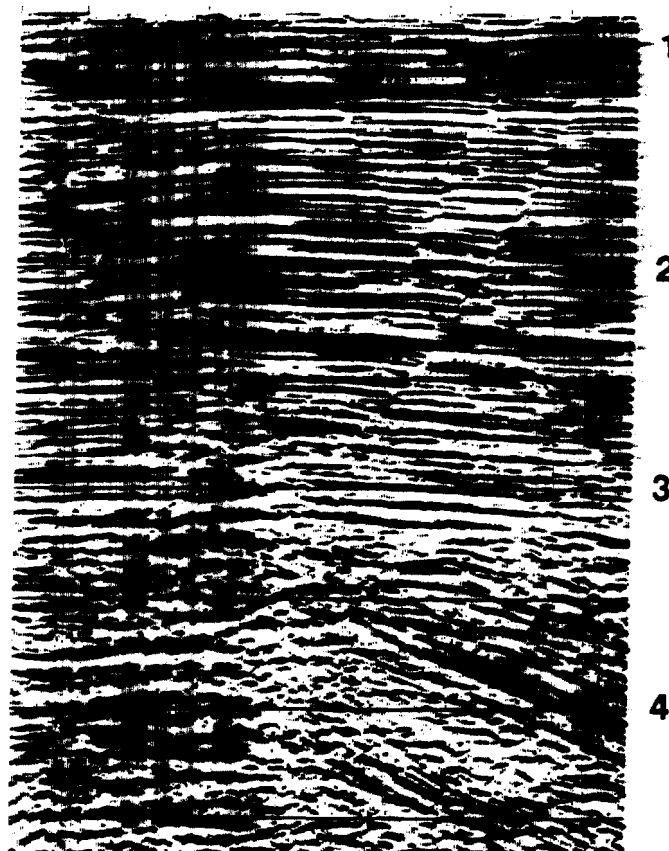


FIGURE 1B

## 3-D Migration





this limit. If successful, additional step-out wells are drilled looking for the edge of the field, and adjacent faults and structurally separated traps within the prospect are tested.

This procedure determines where the reserves are, how many wells will be needed, how large and where to place the platform(s), and what size of gathering system is needed. Obviously, drilling the field by using "throw away" wells greatly increases the cost of evaluating a prospect.

A high quality 3-D seismic survey, on the other hand, can produce very accurate maps of the subsurface conditions, and can replace the hit and miss drilling procedure. Interpreted on interactive workstations, it is possible to quickly evaluate attributes contained within the seismic signal itself. Reflection strength (amplitude), phase and frequency attributes can aid the explorationist in interpreting the lithology and fluid content of a prospective formation.

Amplitude and other reflection attributes, when displayed on a time slice flattened on a horizon containing a gas sand, for example, can in many cases show the outline of the gas/water contact.

Furthermore, fault blocks frequently too small to be seen on 2-D seismic data since they may fall inside the coarser spaced grids, can be more accurately evaluated with fewer exploratory wells. Hence, overall costs are greatly reduced.

This breaks the traditional mind-set that a company must drill large prospects to offset the high risk involved in exploratory drilling. It is true that it costs the same to drill a well on a large prospect as it does to drill a well on a small one, and we heartily recommend drilling the largest prospect available.

But the bottom line is, that for some operators, predicting 10 billion cubic feet of gas with a high degree of confidence can produce a better economic scenario than predicting 100 Bcf with a low degree of confidence. This is the secret of the successful 3-D explorationist.

### Gulf Coast Resurrection

One of the most prolific trends in the Gulf of Mexico lies in the shallow waters off the coast of Louisiana. The region is blanketed with 2-D seismic data, and many of its areas have previously been condemned by dry holes.

But today, high-quality 3-D seismic

data is revealing details of the subsurface that couldn't have been imagined before the advent of computer-aided seismic mapping and interpretation.

In providing more accurate and detailed subsurface images, 3-D seismic data can reveal both subtle and dramatic differences over previous 2-D data. In a comparison of migrations of the same data set (Figures 1A and 1B), the 4.5-second sections show greatly improved fault definition on crossing faults, as well as truncated events not apparent on the 2-D section.

Besides improving the definition of faults, 3-D can also better define the strata within fault blocks, and can indicate rollovers which simply aren't apparent on 2-D migrations. Such was the case in one instance where a rollover wasn't seen on high quality 2-D. By adding higher-resolution 3-D data to the evaluation, the operator generated a prospect which when drilled, yielded two wells which tested at 1,400 and 2,000 barrels of oil a day.

As a 3-D data base is examined, one can find undrilled prospects, both structural and stratigraphic, and can see why some wells missed their intended targets. Figure 2 shows an abandoned, single-

# You Didn't Get Into Geology To S



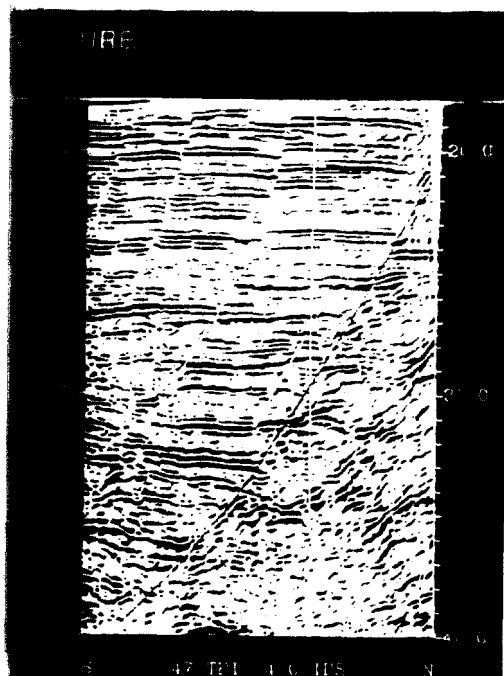
You got into it to use your imagination. To translate mountains of raw data into a complex subterranean landscape no human has ever seen. But far too often it's data – and the time it takes to correlate it – that consumes the lion's share of your attention.

So get out from under all that

paper with Landmark – the pioneer, the innovator in 3D seismic, now offering geologists the ultimate geologic solution: a well-balanced portfolio of CAEX applications, including StratWorks® for geologic interpretation and analysis; Zycor's Z-MAP Plus™, the industry's premier software for mapping and modeling;

PetroWorks™ for well log analysis; and Landmark's GeoDataWorks™ for graphical data management – all supported in OpenWorks®, Landmark's framework for application integration.

Remember why you got into geology in the first place? Only Landmark has the geologic solution to put you back on the right track. Imagine that.



well field with what we believe is a missed opportunity to have produced more reserves.

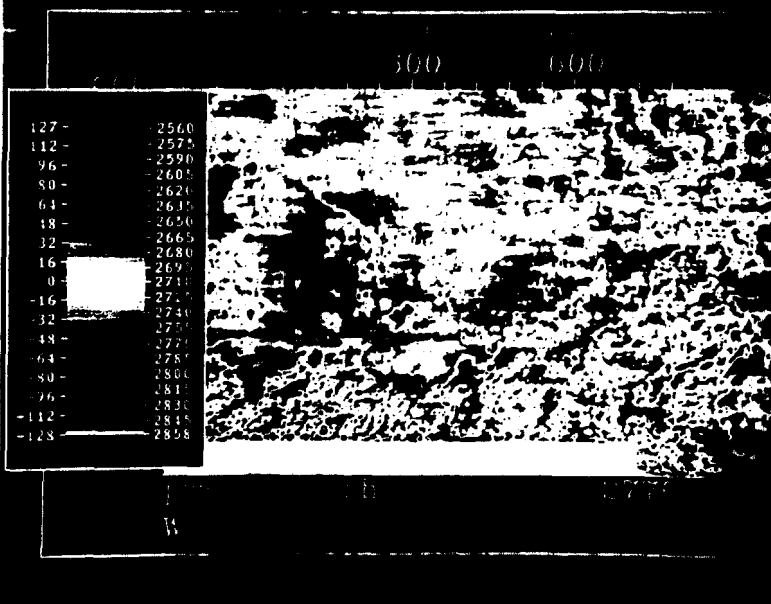
The well was drilled in 1976 for a deeper objective which proved unsuccessful. It was later completed in the Planulina in 1978, with perforations between 11.182 and 11.213 feet. This zone is indicated in yellow, and is bounded by light and dark blue faults. The small fault indicated in green, which cuts the pay zone at the well, was probably never seen

on the 2-D data, and since there were no other wells within the fault block with which to correlate, it went undetected.

In Figure 3, the northwest to southeast section shows a small bright spot covering 260 acres above 2.8 seconds. A few hundred feet to the south-southeast is a dry hole drilled by a previous operator. A discovery well indicates reserves of 10 Bcf of natural gas.

Again, by historical evaluation standards, this may seem a very small discov-

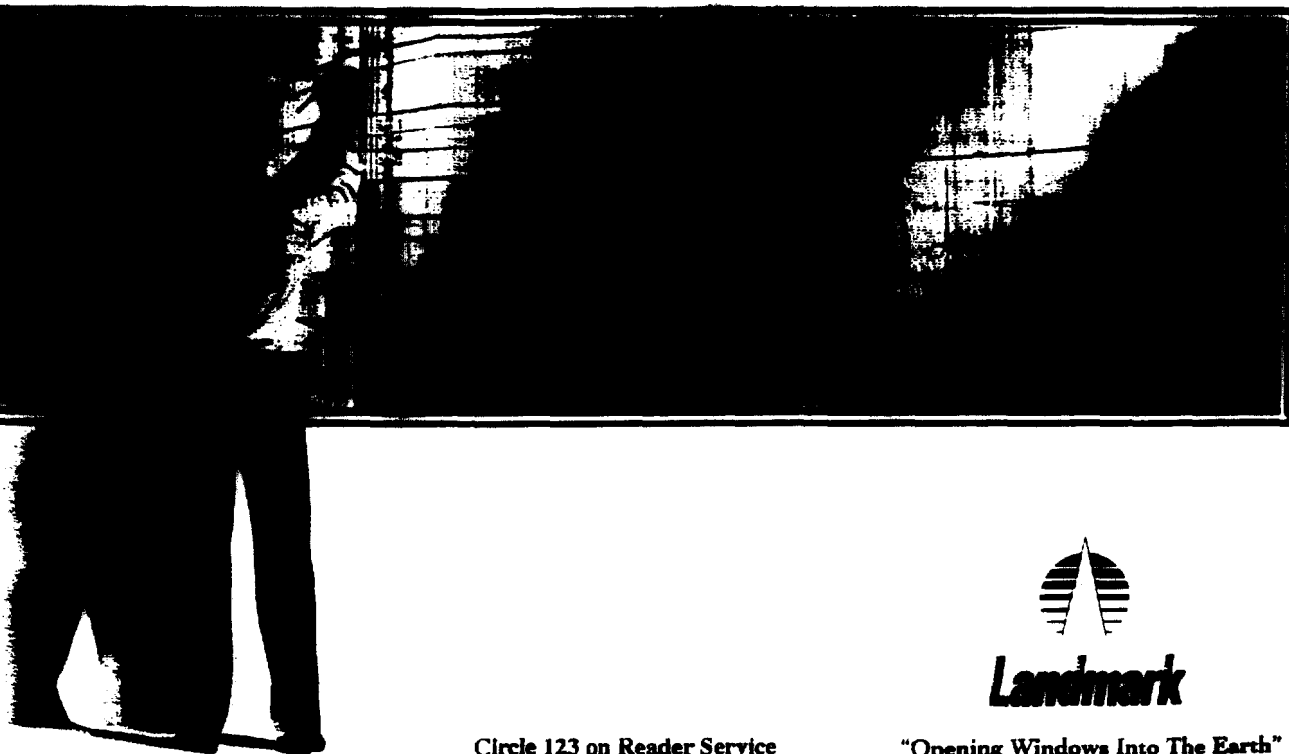
FIGURE 3



ery. The increased confidence gained from using 3-D data reduced the risk, however, and the operator coupled his confidence with the shallow water depths and low development costs for an economic success.

In yet another example of how 3-D can improve the odds for drilling success, a small independent performed a detailed 3-D survey in the Gulf in 1991. Upon interpreting the data, he identified 30 drilling locations, most of which fell within

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discreet fault blocks associated with a large salt dome. The independent went on to complete 10 of the 14 wells he drilled, an uncanny performance by the traditional standards that graded offshore Gulf of Mexico operations before 3-D seismic entered the picture (see "Independent Hits The Jackpot Combining MWD and 3-D," *The American Oil & Gas Reporter*, October 1992).

### Deeper Horizons

One other note of significance is the high quality of deep data below 3.5 seconds, and the large size of the deeper undrilled structures revealed in examining the 3-D data base for the shallow Louisiana waters of the offshore Gulf of Mexico. No one has yet drilled this deep in this area.

Prior to the growing use of 3-D data to better delineate shallow water prospects, there hasn't been a great deal of interest in

deeper horizons. The previously available 2-D data limitations prevented any significant imaging of the deeper subsurface potential.

Hopefully, the proponents of deep hydrocarbon accumulations in the Gulf of Mexico can take advantage of this new view of the subsurface and the lower risks made possible by 3-D to test deeper production horizons.

Although 3-D acquisition, interpretation and processing technology is still in a youthful stage, it is growing up quickly. A look to the future certainly reveals the excitement with which more independents are using 3-D seismic to improve the economics of their exploration and exploitation processes.

The field is full of qualified seismic data interpreters—the skilled geophysical minds who have left the ranks of the majors and who are available to forward-thinking independents. And on the most positive note, there is certainly a new lease on life for the return of development drilling to areas like the Gulf that were written off as having been drained of the lucrative production that 3-D seismic data can prove still remains.

Prospects below 18,000-20,000 feet will begin to be developed and pursued with the aid of 3-D seismic. One of the reasons is that deep wells are extremely expensive in the offshore Gulf, on the

order of \$20 million for a 20,000-foot plus well. Thus 3-D is a necessity to reduce risks.

Within three years, the prime areas of the Gulf of Mexico will be covered by speculative 3-D surveys. Those companies not using 3-D as an exploration tool will be left behind because funding for prospects not generated with 3-D seismic will be difficult to obtain.

Certainly 3-D is more expensive than 2-D seismic data. For example, in the 1980s, an Outer Continental Shelf lease block with a one-half by one-half mile grid of 2-D seismic data could be evaluated for less than \$10,000 in seismic costs. Today, the same block covered with 3-D data could cost \$50,000-\$500,000, depending on parameters, whether it was acquired with streamer methods or shallow water methods, and lease status.

Some independents have realized this economic reality, and have rationalized it with lowered risk and improved success ratios. Forward-looking independents who have fully accepted 3-D are limiting their financial exposure by committing to ongoing 3-D speculative prospects by various contractors at discounted rates.

These companies will not only obtain less expensive 3-D coverage, but they will also be getting the first look at the new subsurface being opened in the Gulf of Mexico. □



MARC A. LAWRENCE

Marc A. Lawrence is vice president and a member of the board of Fairfield Industries. He joined Fairfield in 1977, and has 19 years industry experience, including serving as a senior engineer with R.J. Brown, manager of coastal engineering with Perry Oceanographics Inc., and as a marine geologist with Dames and Moore. Lawrence holds an M.S. in marine geology from the University of Florida.

HUGH LOGUE is a geophysicist with Fairfield Industries, where his primary duties consist of showing 3-D speculative data on the Landmark interactive terminal, and doing regional interpretations in support of speculative sales. He joined Fairfield in 1987, bringing three years experience in gravity, magnetic, and seismic data acquisition, five years of seismic data processing, and 18 years of seismic interpretation. Logue holds a B.S. in geology from the Missouri School of Mines and Metallurgy.

## 3-D Data, Computers Bringing Structural Imaging Into Focus

By John Greenway

PARIS—Structural imaging is the general term for placing structures seen on seismic data into their real positions in space. It is an important link between geophysicists who make images, and geologists who drill rocks.

Standard seismic sections give an indication of sub-surface structure, but not necessarily an accurate one. This is because the travel paths of seismic waves are distorted when they pass through the earth, particularly in the presence of complex structures and rapidly varying velocities.

There is an analogy with optics here: It is a little like looking into a distorted mirror. The reflected image you see (the seismic data) may not look much like the original object (the subsurface geology), although certain features can be recognized. Structural imaging is simply the art

of reconstructing the original object from the distorted image. To do the reconstruction accurately, one needs an initial structural model, and importantly, a good handle on seismic velocities.

True structural imaging is not really applicable to two-dimensional data sets. It is well known that 2-D seismic data sets often contain seismic returns which are not derived from reflectors directly under the survey line. Therefore, correctly positioning these reflections on the seismic section is impossible.

This is the reason why it is only recently that structural imaging has come into focus. Its importance has developed in parallel with the growing displacement of 2-D seismic by 3-D in seismic surveying.

A second reason for increased attention is the development of new computer technologies. Imaging algorithms are highly computer intensive, and if this

**ATTACHMENT B**

### **90.731 RESTRICTIONS ON OPERATIONAL-FIXED STATIONS.**

Except for control stations ~~and as otherwise noted below~~, operational-fixed stations will not be authorized in the 220-222 MHz band. ~~It is noted, licensees may utilize their authorized frequencies only for fixed ancillary signaling and data transmissions, subject to the following requirements:~~

- (a) All such ancillary operations must be on a secondary, non-interference basis to the primary mobile operation of any other licensee.
- (b) The output power at the remote site shall not exceed 30 watts.
- (c) Any fixed transmitters will not be considered in whole or in part as a justification for authorizing additional frequencies in the licensee's mobile system.
- (d) Automatic means must be provided to deactivate the remote transmitter in the event the carrier remains on for a period in excess of three minutes.
- (e) Operational fixed stations authorized pursuant to the provisions of this section are exempt from the requirements of §90.735.
- ~~(f) Notwithstanding the foregoing, temporary fixed geophysical telemetry systems may be licensed in the 220-222 MHz band on a non-ancillary basis.~~

### **90.733 PERMISSIBLE OPERATIONS.**

- (a) Systems authorized in the 220-222 MHz band may be used:
  - (1) Only for base/mobile and mobile relay transmissions on a primary basis, and fixed voice signaling and paging transmissions ancillary to land mobile use ~~except that systems may be licensed for geophysical telemetry on a temporary fixed basis, which operations need not be ancillary to a primary land mobile use by the licensee.~~ Fixed-only and paging-only operations are not permitted in this band.
  - (2) Only by persons who are eligible for facilities under either this subpart or in the radio services included subparts B, C, D, or E of this part.